US009767521B2

(12) **United States Patent**
Stuber et al.

(10) **Patent No.: US 9,767,521 B2**
(45) **Date of Patent: Sep. 19, 2017**

(54) **AGRICULTURAL SPATIAL DATA PROCESSING SYSTEMS AND METHODS**

(71) Applicant: **THE CLIMATE CORPORATION**, San Francisco, CA (US)

(72) Inventors: **Jakob Stuber**, Tremont, IL (US); **Tim Reddy**, Washington, IL (US)

(73) Assignee: **THE CLIMATE CORPORATION**, San Francisco, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 318 days.

(21) Appl. No.: **14/475,431**

(22) Filed: **Sep. 2, 2014**

(65) **Prior Publication Data**

US 2015/0066932 A1 Mar. 5, 2015

Related U.S. Application Data

(60) Provisional application No. 61/872,291, filed on Aug. 30, 2013.

(51) **Int. Cl.**
G06Q 50/02 (2012.01)

(52) **U.S. Cl.**
CPC ***G06Q 50/02*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 17/3071; G06F 17/30864
USPC 707/737
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,343,761	A	9/1994	Myers	
6,285,198	B1	9/2001	Nelson et al.	
8,078,367	B2	12/2011	Sauder et al.	
8,561,472	B2	10/2013	Sauder et al.	
2007/0146364	A1*	6/2007	Aspen	G01C 23/005 345/426
2011/0218821	A1*	9/2011	Walton	G06F 19/322 705/3
2013/0144827	A1*	6/2013	Trevino	G06N 5/02 706/46
2014/0278696	A1*	9/2014	Anderson	G06Q 10/06313 705/7.23

FOREIGN PATENT DOCUMENTS

WO	2012/129442	A2	9/2012
WO	2012/149398	A1	11/2012
WO	2012/149415	A1	11/2012
WO	2013/023142	A1	2/2013
WO	2014/026183	A2	2/2014

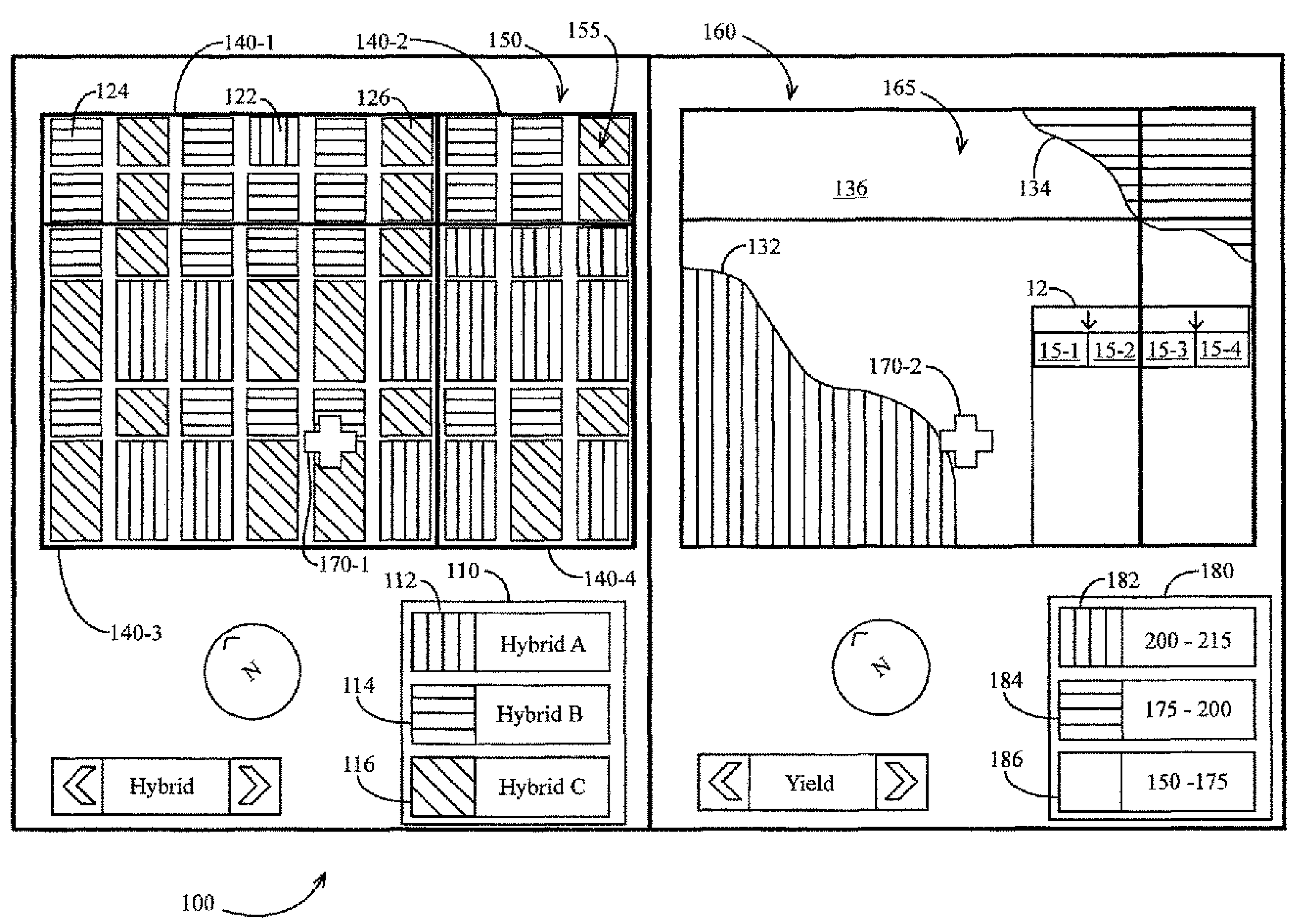
* cited by examiner

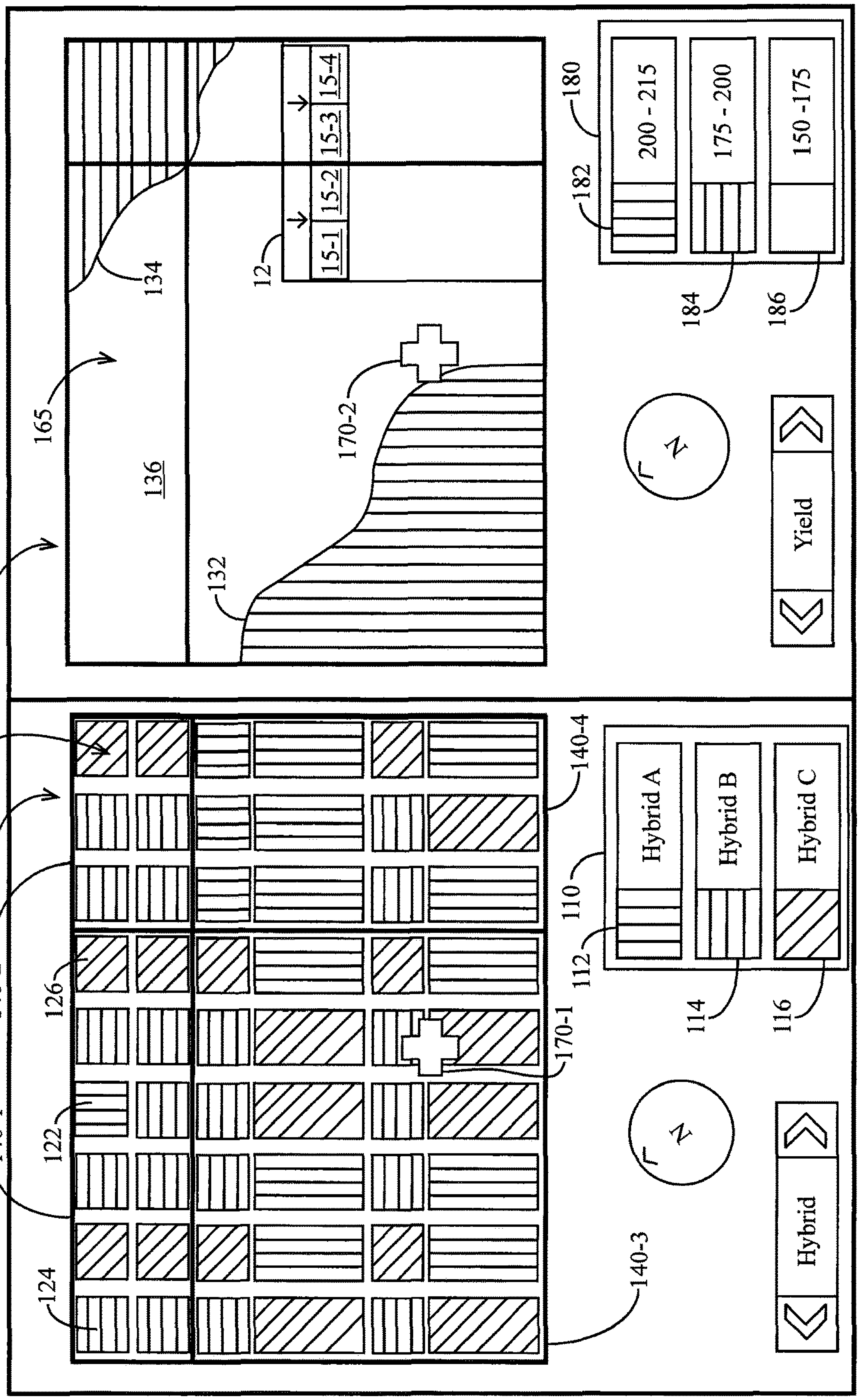
Primary Examiner — Kris Mackes
Assistant Examiner — Allen Lin
(74) *Attorney, Agent, or Firm* — Hickman Palermo Becker Bingham LLP

(57) **ABSTRACT**

Systems and methods are provided for correlating data from agricultural operations and displaying the resulting correlations. In some embodiments, data is gathered during two agricultural operations, a bitmap is rendered of the first operation, and second operation data from a live location is associated with a bitmap value at coordinates associated with the live location.

16 Claims, 9 Drawing Sheets




160
165
136
134
132
170-2
12
15-1
15-2
15-3
15-4
180
182
200 - 215
175 - 200
150 -175
184
186
N
Yield
155
150
140-2
140-1
140-3
140-4
126
122
124
170-1
110
112
Hybrid A
Hybrid B
Hybrid C
114
116
N
Hybrid

100

FIG. 1

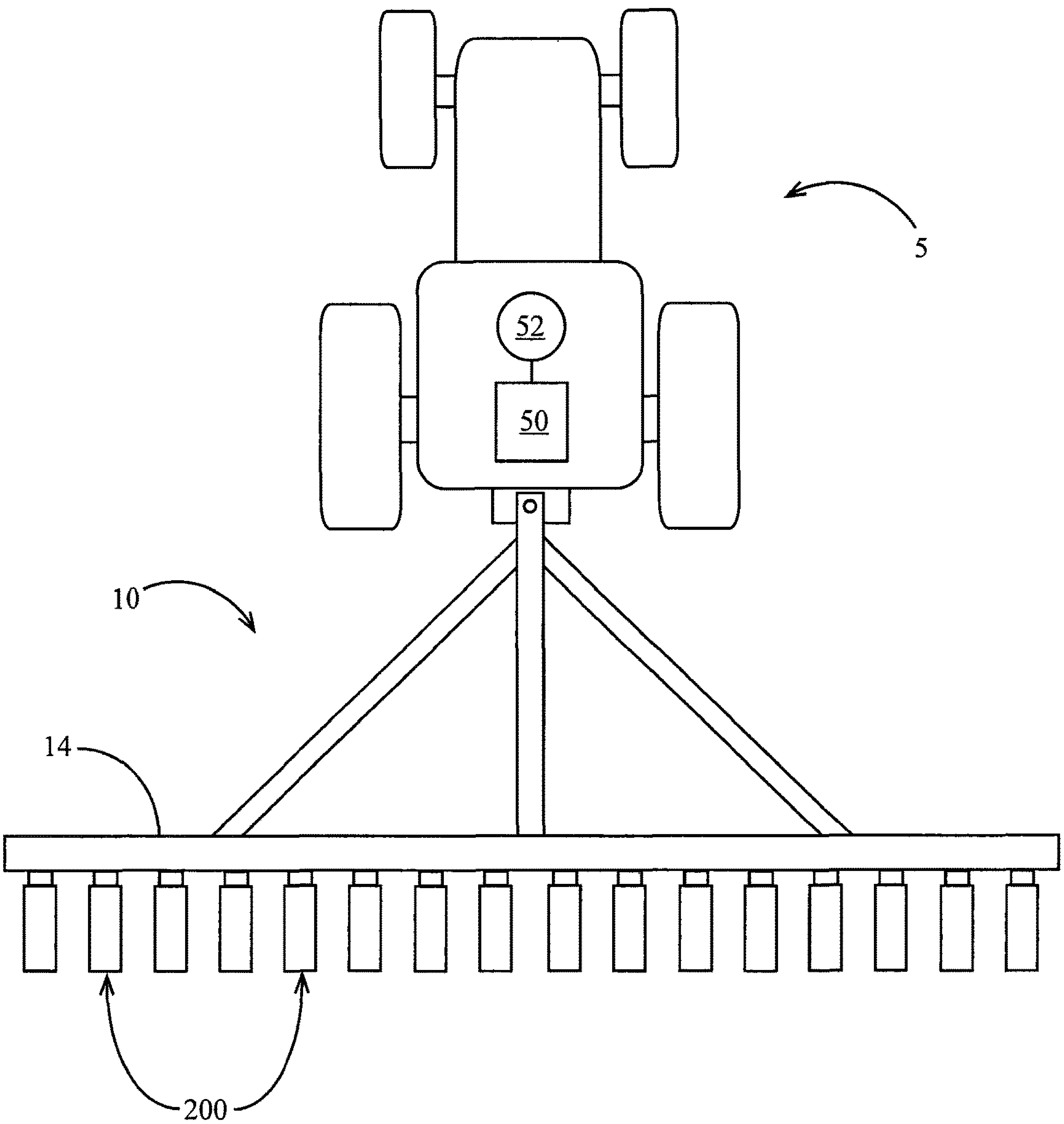


FIG. 2

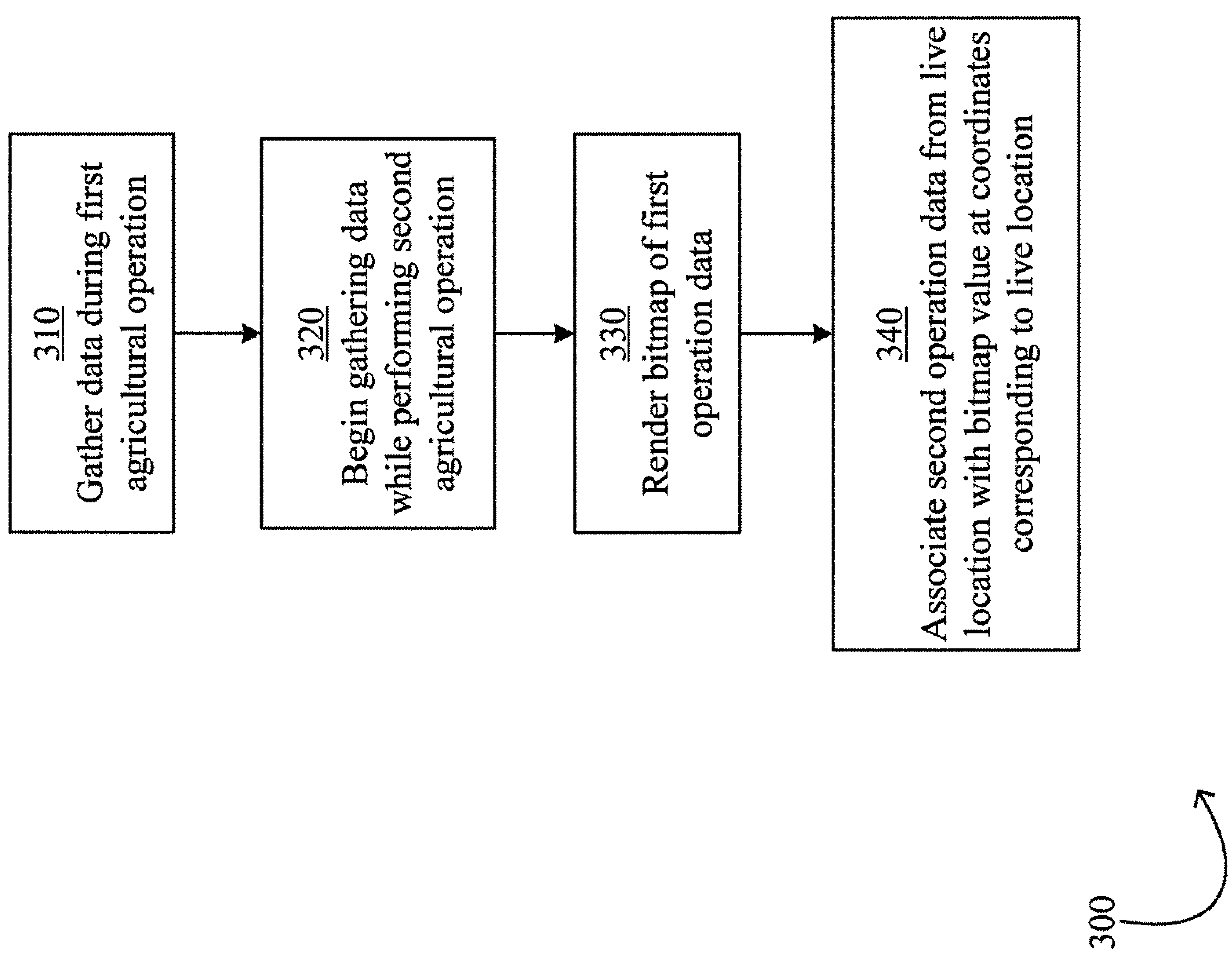
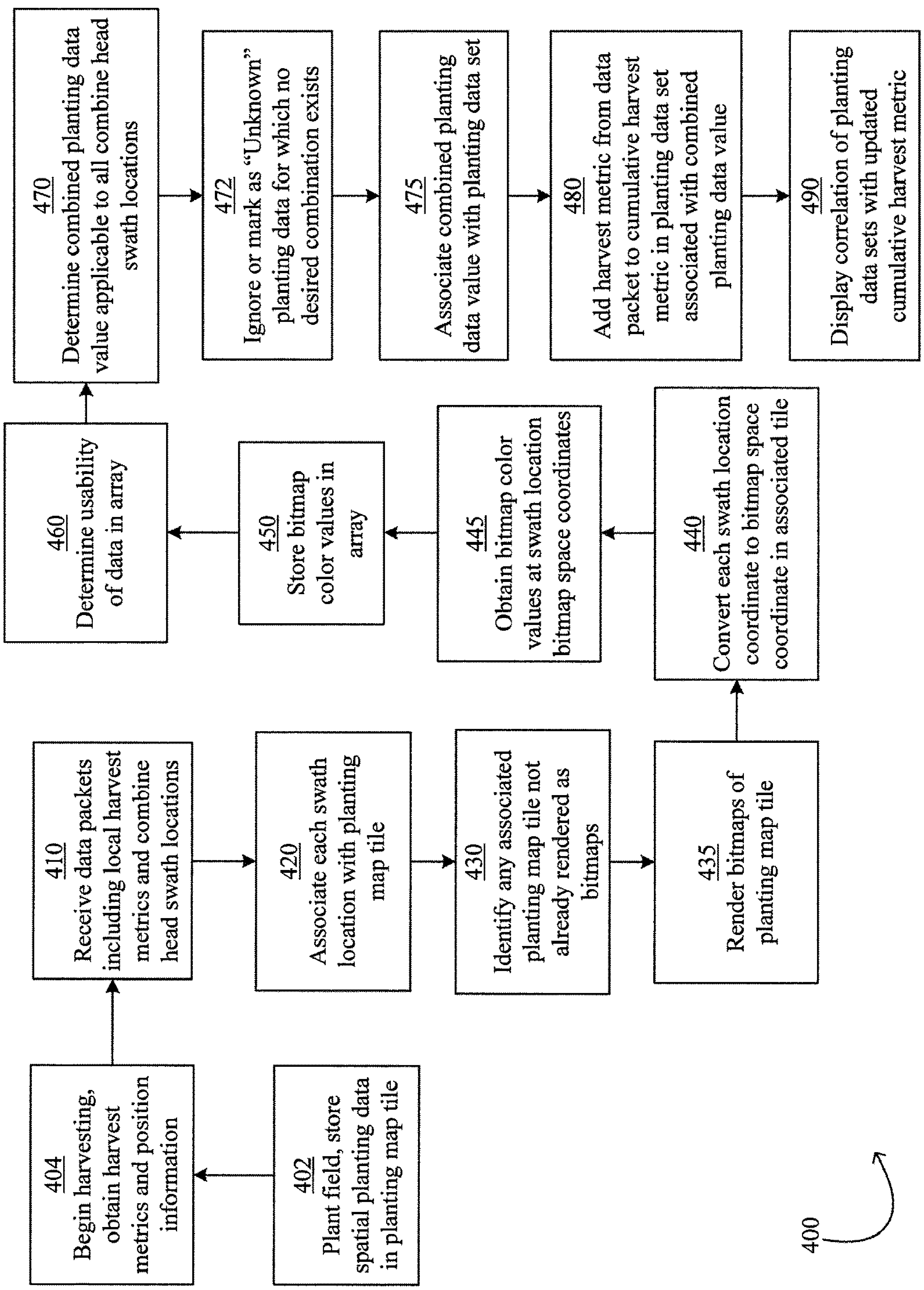

310
Gather data during first agricultural operation
320
Begin gathering data while performing second agricultural operation
330
Render bitmap of first operation data
340
Associate second operation data from live location with bitmap value at coordinates corresponding to live location
300

FIG. 3



402 Plant field, store spatial planting data in planting map tile
404 Begin harvesting, obtain harvest metrics and position information
410 Receive data packets including local harvest metrics and combine head swath locations
420 Associate each swath location with planting map tile
430 Identify any associated planting map tile not already rendered as bitmaps
435 Render bitmaps of planting map tile
440 Convert each swath location coordinate to bitmap space coordinate in associated tile
445 Obtain bitmap color values at swath location bitmap space coordinates
450 Store bitmap color values in array
460 Determine usability of data in array
470 Determine combined planting data value applicable to all combine head swath locations
472 Ignore or mark as "Unknown" planting data for which no desired combination exists
475 Associate combined planting data value with planting data set
480 Add harvest metric from data packet to cumulative harvest metric in planting data set associated with combined planting data value
490 Display correlation of planting data sets with updated cumulative harvest metric
400

FIG. 4

500

510

Population (seeds/ac)	Acres	Yield (bu/ac)	Moisture (%)
28k - 30k	1	181	31
30k-32k	6	205	29
32k-34k	3	159	33
Unknown	5	187	31
Totals	15	188.2	30.6

512 514 516 518

520

Hybrid	Acres	Yield (bu/ac)	Moisture (%)
A	2	157	30
B	8	200	30.4
C	2	183	32
Unknown	3	181	31
Totals	15	188.2	30.6

522 524 526 528

FIG. 5

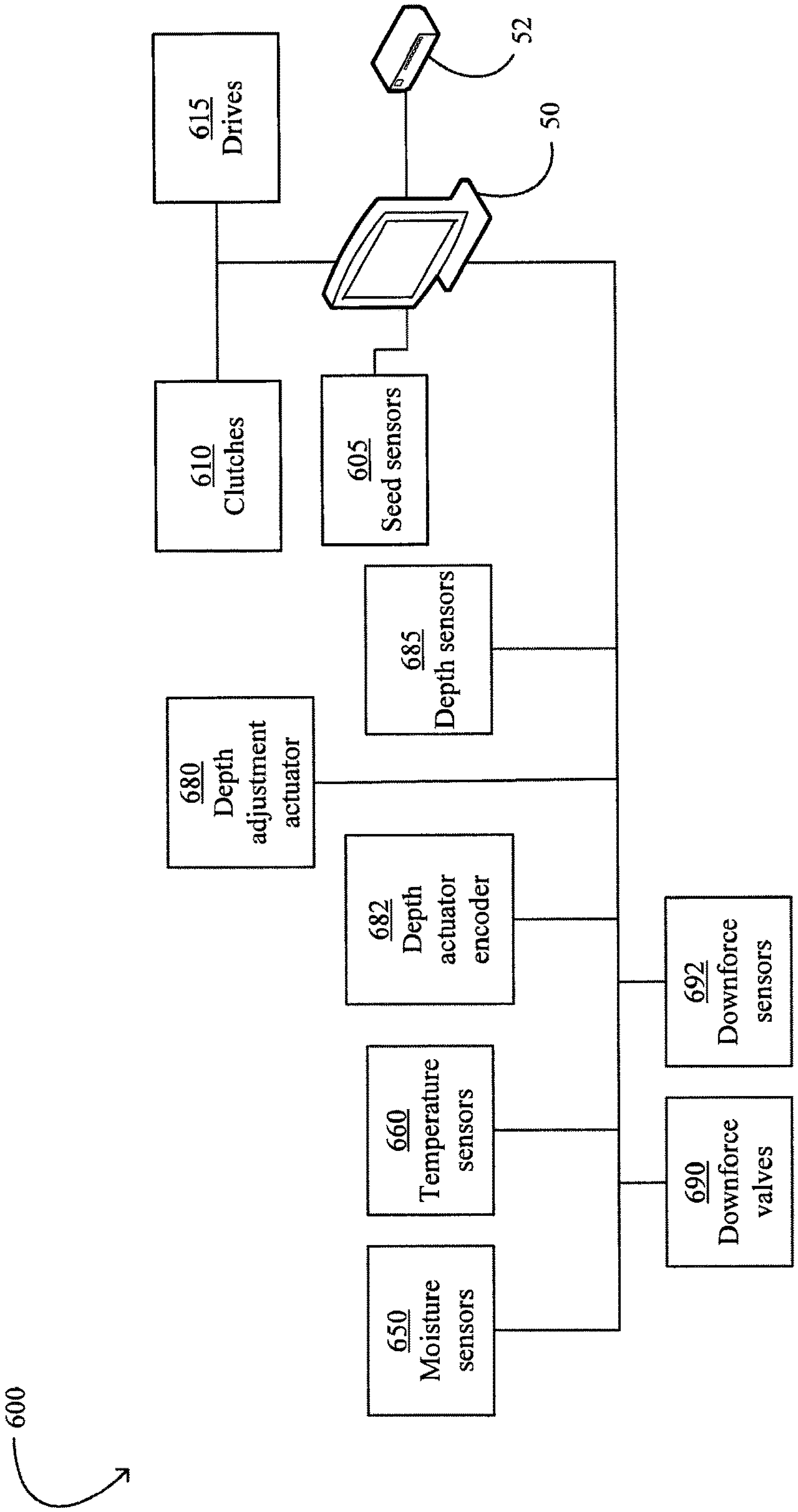

600
52
50
615 Drives
610 Clutches
605 Seed sensors
685 Depth sensors
680 Depth adjustment actuator
682 Depth actuator encoder
692 Downforce sensors
660 Temperature sensors
690 Downforce valves
650 Moisture sensors

FIG. 6

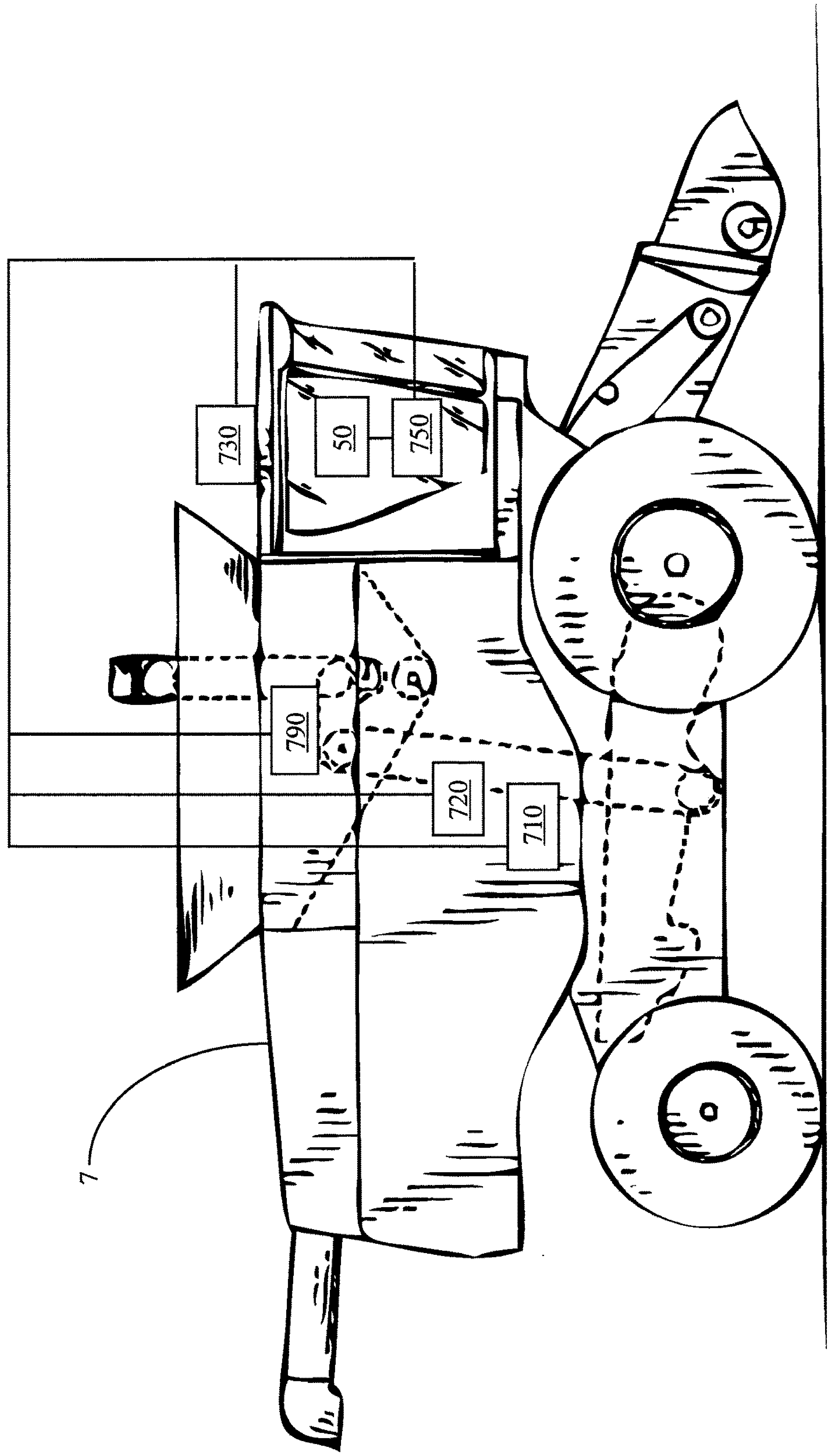
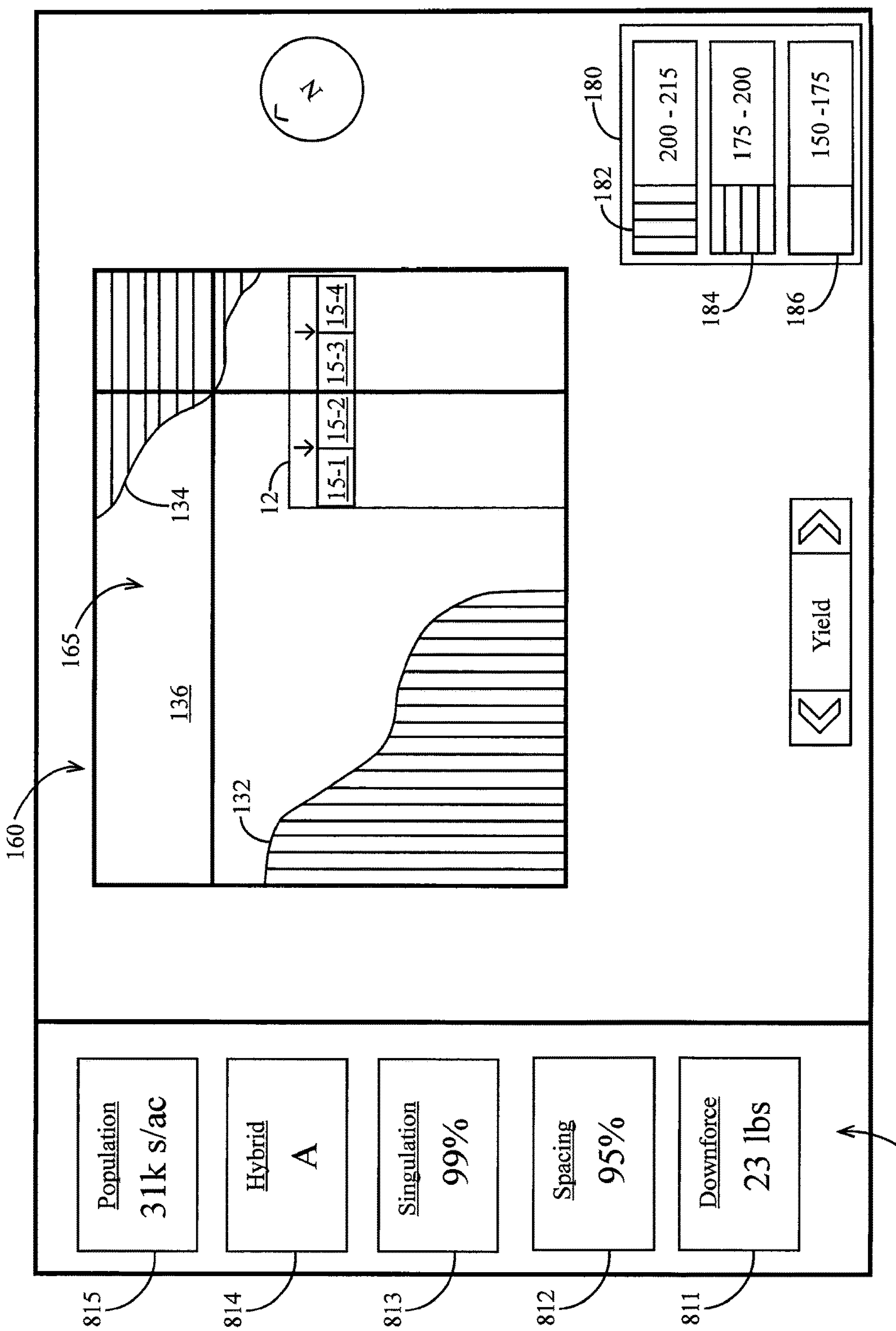


FIG. 7



Population
31k s/ac
Hybrid
A
Singulation
99%
Spacing
95%
Downforce
23 lbs
Yield
200 - 215
175 - 200
150 -175
N
15-1
15-2
15-3
15-4
136
160
165
132
134
12
180
182
184
186
800
810
811
812
813
814
815

FIG. 8

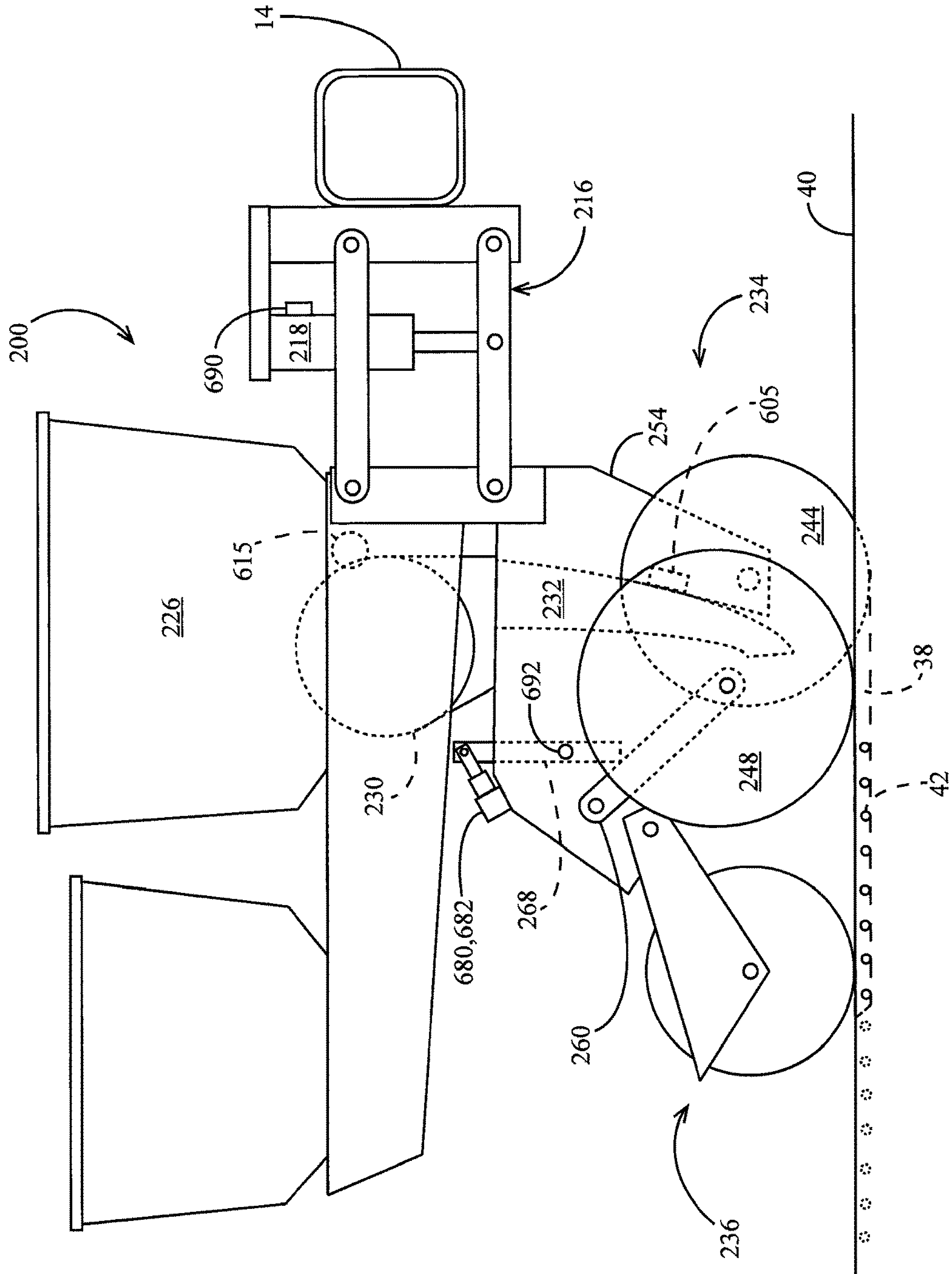

14
216
40
234
200
690
218
605
254
244
615
226
232
692
38
230
248
42
268
680,682
260
236

FIG. 9

AGRICULTURAL SPATIAL DATA PROCESSING SYSTEMS AND METHODS

BACKGROUND

Precision farming practices have been implemented in recent years in order to effectively modify farming practices by location within fields in order to maximize yield and economic return. Existing mapping technology is capable of displaying various maps of agricultural application and yield data. However, there is a need in the art for systems and methods for more effectively displaying such yield data, particularly during operations in the field.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an embodiment of a monitor screen displaying a live harvesting map and a prior planting map.

FIG. **2** is a top view of an embodiment of a planting implement drawn by a tractor.

FIG. **3** illustrates an embodiment of a process for correlating data between two agricultural operations.

FIG. **4** illustrates another embodiment of a process for correlating data between two agricultural operations.

FIG. **5** illustrates an embodiment of a monitor screen displaying a report correlating planting data and harvest data.

FIG. **6** illustrates an embodiment of a planter monitoring system.

FIG. **7** illustrates an embodiment of a harvest data collection system.

FIG. **8** illustrates another embodiment of a monitor screen displaying a live harvesting map and numerical planting metrics.

FIG. **9** illustrates an embodiment of a planter row unit.

DESCRIPTION

Planter Data Collection System

Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, FIG. **2** illustrates a tractor **5** drawing an agricultural implement, e.g., a planter **10**, comprising a toolbar **14** operatively supporting multiple row units **200**. An implement monitor **50** preferably including a central processing unit ("CPU"), memory and graphical user interface ("GUI") (e.g., a touch-screen interface) is preferably located in the cab of the tractor **10**. A global positioning system ("GPS") receiver **52** is preferably mounted to the tractor **10**.

Turing to FIG. **9**, an embodiment is illustrated in which the row unit **200** is a planter row unit. The row unit **200** is preferably pivotally connected to the toolbar **14** by a parallel linkage **216**. An actuator **218** is preferably disposed to apply lift and/or downforce on the row unit **200**. A solenoid valve **690** is preferably in fluid communication with the actuator **218** for modifying the lift and/or downforce applied by the actuator. An opening system **234** preferably includes two opening discs **244** rollingly mounted to a downwardly-extending shank **254** and disposed to open a v-shaped trench **38** in the soil **40**. A pair of gauge wheels **248** is pivotally supported by a pair of corresponding gauge wheel arms **260**; the height of the gauge wheels **248** relative to the opener discs **244** sets the depth of the trench **38**. A depth adjustment rocker **268** limits the upward travel of the gauge wheel arms **260** and thus the upward travel of the gauge wheels **248**. A depth adjustment actuator **680** is preferably configured to modify a position of the depth adjustment rocker **268** and thus the height of the gauge wheels **248**. The actuator **680** is preferably a linear actuator mounted to the row unit **200** and pivotally coupled to an upper end of the rocker **268**. In some embodiments the depth adjustment actuator **680** comprises a device such as that disclosed in International Patent Application No. PCT/US2012/035585, the disclosure of which is hereby incorporated herein by reference. An encoder **682** is preferably configured to generate a signal related to the linear extension of the actuator **680**; it should be appreciated that the linear extension of the actuator **680** is related to the depth of the trench **38** when the gauge wheel arms **260** are in contact with the rocker **268**. A downforce sensor **692** is preferably configured to generate a signal related to the amount of force imposed by the gauge wheels **248** on the soil **40**; in some embodiments the downforce sensor **692** comprises an instrumented pin about which the rocker **268** is pivotally coupled to the row unit **200**, such as those instrumented pins disclosed in Applicant's co-pending U.S. patent application Ser. No. 12/522,253 (Pub. No. US 2010/0180695), the disclosure of which is hereby incorporated herein by reference.

Continuing to refer to FIG. **9**, a seed meter **230** such as that disclosed in Applicant's co-pending International Patent Application No. PCT/US2012/030192, the disclosure of which is hereby incorporated herein by reference, is preferably disposed to deposit seeds **42** from a hopper **226** into the trench **38**, e.g., through a seed tube **232** disposed to guide the seeds toward the trench. In some embodiments, the meter is powered by an electric drive **615** configured to drive a seed disc within the seed meter. In other embodiments, the drive **615** may comprise a hydraulic drive configured to drive the seed disc. A seed sensor **605** (e.g., an optical or electromagnetic seed sensor configured to generate a signal indicating passage of a seed) is preferably mounted to the seed tube **232** and disposed to send light or electromagnetic waves across the path of seeds **42**. A closing system **236** including one or more closing wheels is pivotally coupled to the row unit **200** and configured to close the trench **38**.

Turning to FIG. **6**, a planter monitoring system **600** is schematically illustrated. The monitor **50** is preferably in electrical communication with components associated with each row unit **200** including the drives **315**, the seed sensors **605**, the GPS receiver **52**, the downforce sensors **692**, the valves **690**, the depth adjustment actuator **680**, the depth actuator encoders **682**, and the solenoid valves **690**. In some embodiments, particularly those in which each seed meter **230** is not driven by an individual drive **615**, the monitor **50** is also preferably in electrical communication with clutches **610** configured to selectively operably couple the seed meter **230** to a hydraulic drive or other seed meter drive.

Continuing to refer to FIG. **6**, the monitor **50** is also preferably in electrical communication with one or more temperature sensors **660** such as one of the embodiments described in Applicant's U.S. Provisional Patent Application No. 61/783,591 ("the '591 application") and Applicant's International Patent Application No. PCT/US2012/035563, the disclosures of both of which are hereby incorporated herein in their entirety by reference. The monitor **50** is preferably in electrical communication with one or more moisture sensors **650** such as those disclosed in the '591 application, incorporated by reference above. In some embodiments the monitor **50** is in electrical communication with planting depth sensors **685**.

Harvest Data Collection System

A harvest data collection system **700** is illustrated in FIG. **7** schematically superimposed on a combine harvester **7**, indicating preferred component mounting locations on the combine harvester. The harvest data collection system **700** preferably includes a yield sensor assembly **790**. The yield sensor assembly **790** is preferably one of the embodiments disclosed in Applicant's International Patent No. PCT/US2012/050341 or U.S. Pat. No. 5,343,761,the disclosures of both of which are hereby incorporated herein in their entirety by reference. The harvest data collection system **700** preferably further includes a further a grain height sensor **710**, a moisture sensor **720**, a global positioning system (GPS) receiver **730**, a processing board **750**, and the monitor **50**. The processing board **750** is preferably in data communication with the monitor **50**, the yield sensor assembly **790**, the grain height sensor **710**, the moisture sensor **720**, and the GPS receiver **730**. In a preferred embodiment the monitor **50** is the same monitor used in the planter monitor system **600**. In other embodiments, a second monitor having a processor, memory and graphical user interface may be used in the harvest data collection system **700** to replace the monitor **50**.

The grain height sensor **710** preferably comprises a sensor configured and disposed to measure the height of grain being lifted by the clean grain elevator. The grain height sensor **710** is preferably mounted to the sides of a clean grain elevator housing adjacent the location where grain piles are lifted vertically before reaching the top of the clean grain elevator. It should be appreciated that the grain height sensor **710** is not required for operation of the harvest data collection system **700** or the yield sensor assembly **790**.

The moisture sensor **720** preferably comprises a sensor disposed to measure the moisture of grain being lifted by the clean grain elevator. For example, in some embodiments the moisture sensor **720** comprises a capacitive moisture sensor such as that disclosed in U.S. Pat. No. 6,285,198, the disclosure of which is hereby incorporated by reference herein in its entirety.

The GPS receiver **730** preferably comprises a receiver configured to receive a signal from a GPS or similar geographical referencing system. The global positioning receiver **730** is preferably mounted to the top of the combine **7**.

The processing board **750** preferably comprises a central processing unit (CPU) and a memory for processing and storing signals from the system components **710**, **720**, **790**, **730** and transmitting data to the monitor **50**. The monitor **50** is preferably mounted inside a cab of the combine **7**.

Monitoring Methods

Correlations

In operation, a first monitoring system (e.g., the planter monitoring system **600**) preferably collects data during a first operation (e.g., a planting operation) and stores data (e.g., spatial planting data) collected during the first operation. A second monitoring system (e.g., the harvest data collection system **700**) preferably collects data during a second operation (e.g., a harvesting operation) and stores data (e.g., spatial harvest data) collected during the second operation. During the second operation, the second monitoring system preferably displays visual and numerical correlations between the data collected during the first operation and the data collected during the second operation.

One such visual correlation between data collected during first and second agricultural operations is illustrated in FIG. **1**. The monitor **50** is preferably configured to display a map screen **100** (similar to the map screen **1600** disclosed in International Patent Appplication No. PCT/US2013/054506, incorporated herein in its entirety by reference) including a completed planting map window **150** and a live yield map window **160**.

The completed planting map window **150** preferably includes a map layer **155** comprising display tiles **140**. Each display tile **140** preferably includes map blocks **122**, **124**, **126** representing live planting data (e.g., hybrid type) associated with the location of the block. The spatial extent of each display tile **140** is preferably circumscribed by a unique geo-referenced boundary (e.g., a rectangular boundary); depending on the geo-referenced area displayed by the map layer **155**, only a portion of any given display tile **140** may be displayed in the map layer **155** and the map window **150**. The pattern, symbol or color of each map block corresponds to a legend **110** preferably displayed in the completed planting map window **150**. The legend **110** preferably includes a set of legend ranges (e.g., legend ranges **112**, **114**, **116**) including a pattern, symbol or color and a corresponding value range. In FIG. **1**, the legend ranges **112**, **114**, **116** correspond to population ranges. It should be appreciated that the legend ranges **112**, **114**, **116** correspond to map blocks **122**, **124**, **126**, respectively. An annotation **170-1** preferably remains at the same position with respect to the map boundary as the orientation and zoom level of map window **150** are manipulated.

The live yield map window **160** preferably includes a map layer **165** comprising yield map polygons **132**, **134**, **136** (or blocks similar to those used in the planting maps described herein) corresponding to ranges **182**, **184**, **186** of a yield legend **180**. As the combine traverses the field, a combine annotation **12** preferably indicates the current location of the combine within the map Annotations **15** preferably indicate the locations of each combine row unit when using a combine having a header (e.g., a corn header) configured to harvest a crop in discrete rows. An annotation **170-2** preferably remains at the same position with respect to the map boundary as the orientation and zoom level of map window **160** are manipulated.

A second correlation between data collected during first and second agricultural operations is illustrated in FIG. **8**. The monitor **50** is preferably configured to display a map screen **800** including live yield map window **160** (similar to that described above with respect to FIG. **1**) and an array **810** of planting data windows. Each planting data window preferably displays a value of planting data corresponding to the location (the "current location") of the combine harvester **7** (indicated on the map by the annotation **12**). A downforce window **811** preferably displays a downforce applied at the current location during the planting operation. A seed spacing window **812** preferably displays a seed spacing quality—preferably determined as disclosed in U.S. Pat. No. 8,078,367 ("the '367 patent"), incorporated herein by reference—of seeds planted at and/or the current location during the planting operation. A singulation window **813** preferably displays a seed singulation quality—preferably determined as disclosed in the '367 application—of seeds planted at and/or near the current location during the planting operation. A hybrid window **814** preferably identifies a variety (i.e., type) of seeds planted at and/or near the current location during the planting operation. A population window **815** preferably displays a population value—preferably determined as disclosed in the '367 application—of seeds planted at and/or near the current location during the planting operation.

A third correlation between data collected during first and second agricultural operations is illustrated in FIG. **5**. The monitor **50** is preferably configured to display a correlation screen **500** including a plurality of correlation charts **510**, **520**. Each correlation chart **510**, **520** preferably correlates data accumulated during the harvesting operation with subsets of data accumulated during the prior planting operation. Correlation chart **510** preferably contains a plurality of rows correlating population ranges **512** with acreages **514**, yields **516**, and moistures **518** in areas planted at each population range. Correlation chart **520** preferably contains a plurality of rows correlating hybrid types **522** with acreages **524**, yields **526**, and moistures **528** in areas planted with each hybrid type. The correlation charts **512**, **522** are preferably repeatedly or continuously populated with data accumulated during the harvest operation such that the operator may navigate to the correlation screen **500** in order to view correlated data for all of the harvest data (e.g., acreage, yield, and moisture) accumulated thus far during the operation.

Each correlation chart preferably includes an "Unknown" row in which harvest data is accumulated for locations which could not be satisfactorily associated with harvest data; e.g., where yield was measured at a location associated with multiple populations. A common example of such multiple associations may occur when one set of combine header row units is harvesting an area planted at a first population while another set of combine header row units is harvesting an area planted at a second population. Each correlation chart preferably includes a "Totals" row in which all the harvest data is accumulated for each subset of planting data including the "Unknown" subset. In other embodiments, the correlation charts are replaced and/or supplemented with visual correlations such as bar charts or scatter plots.

In addition to population and seed hybrid, other correlation embodiments similar to those above may correlate other planting data including planting depth, planting downforce, planting temperature, and planting moisture.

Data Access and Correlation Methods

Referring to FIG. **3**, in order to display each of the correlations described above between first and second agricultural operations, the monitor **50** is preferably configured to carry out a process **300**. At step **310** the monitor **50** preferably gathers data during a first agricultural operation. At step **320** the monitor **50** preferably begins gathering data while performing a second agricultural operation. At step **330** the monitor **50** preferably renders a bitmap of the data gathered during the first operation. At step **340** the monitor **50** preferably associates the data gathered at a live location (e.g., the current location of the implement) during the second operation with a bitmap value at bitmap coordinates corresponding to the live location.

Turning to FIG. **4**, a detailed process **400** for accessing data collected during a first (e.g., planting) operation during a second (e.g., harvesting) operation is illustrated. At step **402**, an operator preferably carries out a first agricultural operation while a monitor collects spatial data. In the illustrated example the first agricultural operation comprises planting a field while the planter monitor system **600** collects the planting data described herein. At step **404**, an operator preferably begins harvesting a field while the harvest data collection system **700** collects local harvest metrics and position information. At step **410**, the monitor **50** preferably receives data packets at regular intervals (e.g., at 5 Hz frequency) from the sensors in the harvest data collection system **700**; each data packet preferably includes harvest metrics (e.g., yield and moisture) as well as geo-referenced positions associated with the metrics. The geo-referenced positions preferably correspond to the positions of the combine header row units (referred to herein as "swath locations") at the time of (or at an offset time from) the harvest metric measurements in the packet. At step **420**, the monitor **50** preferably associates each swath location with a planting map tile. Each planting map tile preferably includes multiple sets of planting data (e.g., population, singulation, downforce, depth, moisture, temperature) collected during the planting operation at a single set of coordinates, e.g., defined by a rectangular boundary as illustrated in FIG. **1**. The display tiles **140** illustrated in FIG. **1** preferably comprise visual representations of one or more sets of spatial data in a map tile.

At step **430**, the monitor **50** preferably identifies any map tiles that have not been rendered as a desired bitmap or bitmaps.

At step **435** the monitor **50** preferably renders the identified map tiles as a bitmap or bitmaps. In a preferred embodiment, each bitmap comprises a **256** by **256** pixel bitmap, each pixel having a value corresponding to a value or range of values in a data set within the map tile, and the coordinates of each pixel corresponding to a geo-referenced location. As a representative example, a population data set in the map tile is rendered as a population bitmap in which each range of population is assigned a unique color index. As another representative example, a hybrid (seed variety) data set in the map tile is rendered as a hybrid bitmap in which each hybrid type or index is mapped to a color index value. The generated bitmaps are preferably stored in the memory cache of the monitor **50**.

At step **440**, the monitor **50** preferably converts each swath location (received at step **410**) to a bitmap space coordinated in the map tile with which the swath location was associated at step **420**. At step **445**, the monitor **50** preferably obtains bitmap color values at each swath location bitmap coordinate. At step **450** the monitor **50** preferably stores the bitmap color values in an array for each data packet received (i.e., for all the swath locations in the data packet).

At step **460**, the monitor **50** preferably determines the usability of data in each array. In a preferred embodiment, the monitor **50** determines whether the percentage of swath locations successfully associated with a color value in the bitmap (e.g., the population bitmap) exceeds a threshold percentage, e.g. 90%. If the threshold is not met, the data in the array is preferably ignored or added to a "Bad" data set not used for display or correlation purposes by the monitor **50**.

At step **470**, the monitor **50** preferably determines a combined planting data value applicable to all the swath locations represented in the array. As an example, the population bitmap color values for each swath location are averaged such that the combined planting data value comprises an average value of all the swath locations represented in the array. As another example, the hybrid bitmap color values at each swath location are preferably used to identify a hybrid combination applicable to the entire combine head; for example, an "A" hybrid combination if each swath location was planted with seed variety A, a "B" hybrid combination if each swath location was planted with seed variety B, and an "A/B" hybrid combination if some swath locations were planted with seed variety A and others with seed variety B.

If no desired combination exists for a planting data set, then at step **472** the monitor **50** preferably ignores that planting data set or adds it to an "Unknown" data set. For example, if the hybrid data set in a given array includes a combination of hybrids not corresponding to any hybrid combination recognized by the monitor **50** (i.e., existing in a list of combinations stored in the memory of the monitor), then the hybrid data in that array is preferably ignored or added to an "Unknown" hybrid data set.

At step **475**, the monitor **50** preferably associates the combined planting data value determined at step **470** with a planting data set comprising multiple ranges of planting data values. For example, in an illustrative embodiment an averaged population value of 30,010 seeds per acre is associated with a planting data set containing all population values between 30,000 seeds per acre and 30,500 seeds per acre.

At step **480**, the monitor **50** preferably adds the harvest metric from the data packet to a cumulative harvest metric in the planting data set associated with the combined planting value. For example, in an illustrative embodiment a yield measurement (e.g., grain mass flow rate or bushels per acre) in a data packet having an averaged population value of 30,010 seeds per acre is added to an accumulated yield value associated with a planting data set containing all population values between 30,000 seeds per acre and 30,500 seeds per acre.

At step **490**, the monitor **50** preferably displays a correlation (i.e., one of the visual or numerical correlations described above) between planting data sets (e.g., ranges of population) and cumulative harvest metrics (e.g., total harvested bushels per acre in each range of population).

The foregoing description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment of the apparatus, and the general principles and features of the system and methods described herein will be readily apparent to those of skill in the art. Thus, the present invention is not to be limited to the embodiments of the apparatus, system and methods described above and illustrated in the drawing figures, but is to be accorded the widest scope consistent with the spirit and scope of the appended claims.

The invention claimed is:

1. A method of correlating data during a first agricultural operation and a second agricultural operation, comprising:

receiving, from one or more sensors mounted in a planter unit, first data at a first plurality of geo-referenced locations during the first agricultural operation, wherein the receiving occurs while a planting operation is in progress, and wherein said first data comprises planting data from the one or more sensors mounted in the planter unit;

rendering a first bitmap of said first data comprising planting data associated with said first plurality of geo-referenced locations of said first data; and

while a harvesting operation is in progress during the second agricultural operation:

receiving, at regular intervals, from one or more sensors mounted in a harvest unit performing a harvesting operation, second data comprising a set of data packets at a second plurality of geo-referenced location, wherein said second data comprises live harvest yield data from the one or more sensors mounted in the harvest unit performing the harvesting operation, and wherein the second plurality of geo-referenced locations corresponds to combine head swath locations;

rendering a second bitmap of said second data, wherein, at bitmap coordinates corresponding to said second plurality of geo-referenced locations, bitmap values correspond to said second data received at said second plurality of geo-referenced locations;

determining usability of said bitmap values, wherein the usability is based on whether, for a bitmap value corresponding to a geo-referenced location in the first bitmap, there is at least a threshold number of combine head swath locations associated with the bitmap value; and

generating a display map screen comprising the rendered first and second bitmaps, wherein, for bitmap locations that are determined to have usable bitmap values, the values of the received planting data and the received live harvest yield data are displayed in adjacent windows for a same set of geo-referenced locations.

2. The method of claim **1**, wherein said harvest yield data includes a plurality of combine head swath locations.

3. The method of claim **2**, further comprising:

associating each of said plurality of combine head swath locations with a planting map tile.

4. The method of claim **2**, further comprising:

converting each of said plurality of combine head swath locations to bitmap space coordinates.

5. The method of claim **4**, further comprising:

obtaining bitmap values at said bitmap space coordinates.

6. The method of claim **5**, further comprising:

determining a combined planting data value applicable to all of said combine head swath locations for a single combine head position.

7. The method of claim **6**, further comprising:

associating said combined planting data value with a planting data set.

8. The method of claim **7**, further comprising:

adding a harvest metric to a cumulative harvest metric associated with said combined planting data value.

9. The method of claim **8**, further comprising:

displaying a correlation of planting data sets with cumulative harvest metrics.

10. A method of correlating data during a first agricultural operation and a second agricultural operation, comprising:

receiving, from one or more sensors mounted in a planter unit, first data associated with a first plurality of geo-referenced locations during the first agricultural operation, wherein the receiving occurs while a planting operation is in progress, and wherein said first data comprises planting data from the one or more sensors mounted in the planter unit;

rendering a first map of said first data comprising planting data associated with said first plurality of geo-referenced locations of the said first data; and

while a harvesting operation is in progress during the second agricultural operation:

receiving, at regular intervals, from one or more sensors mounted in a harvest unit performing a harvesting operation, second data comprising a set of data packets at a second plurality of geo-referenced locations, wherein said second data comprises live harvest yield data from the one or more sensors mounted in the harvest unit performing the harvesting operation, and wherein the second plurality of geo-referenced locations corresponds to combine head swath locations;

rendering a second map of said second data, wherein, at map coordinates corresponding to said second plurality of geo-referenced locations, map values correspond to said second data received at said second plurality of geo-referenced locations;

determining the usability of said map values, wherein the usability is based on whether, for a map value corresponding to a geo-referenced location in the first map, there is at least a threshold value of combine head swath locations associated with the map value; and

generating a display map screen comprising the rendered first and second maps, wherein, for map locations that are determined to have usable map values, the values of the received planting data and the received live harvest yield data are displayed in adjacent windows for a same set of geo-referenced locations.

11. The method of claim **10**, further comprising:

associating each of said first plurality of locations with a map tile of said map.

12. The method of claim **11**, further comprising:

determining a combined second operation data value applicable to all of said first plurality of locations for a single position reached during said second operation.

13. The method of claim **12**, further comprising:

associating said combined second operation data value with a first operation data set.

14. The method of claim **13**, further comprising:

displaying a correlation of said combined second operation data value with said first operation data set.

15. The method of claim **10**, wherein said harvest data includes a plurality of combine head locations.

16. A method of correlating data during a first agricultural operation and a second agricultural operation, comprising:

receiving, from one or more sensors mounted in a planter unit, first data at a first plurality of geo-referenced locations during the first agricultural operation, wherein the receiving occurs while a planting operation is in progress, and wherein said first data comprises planting data from the one or more sensors mounted in the planter unit;

while a harvesting operation is in progress during the second agricultural operation:

receiving, at regular intervals, from one or more sensors mounted in a harvest unit performing a harvesting operation, second data comprising a set of data packets at a second plurality of geo-referenced locations, wherein said second data comprises live harvest yield data from the one or more sensors mounted in the harvest unit performing the harvesting operation, and wherein the second plurality of geo-referenced locations corresponds to combine head swath locations;

determine the usability of said first data, wherein the usability is based on whether, for a first data value corresponding to a geo-referenced location in the first plurality of geo-referenced locations, there is at least a threshold number of combine head swath locations associated with the first data value; and

determining, for geo-referenced locations that are determined to have usable first data values:

a correlation between the said first data and said second data, wherein the correlation associates values of the received planting data and the received live harvest yield data for a same geo-referenced location; and

generating a display of the correlated planting data and live harvest yield data for said geo-referenced location.

* * * * *